

August 30, 2016

Mr. Bob Allen

Director

Harris County Pollution Control Services

101 S. Richey, Suite H

Pasadena, Texas 77506-1023

Subject: Comments on report titled: "Evaluation of the San Jacinto Waste Pits Feasibility Study Remediation Alternatives", US Army Corps of Engineers (USACE), Engineering Research and Development Center (ERDC), August 2016

Dear Bob,

This letter provides Parsons' comments on the subject report, a revised version of a report with the same title issued in August 2015. The pages of the 2015 report were marked "draft" but there was no indication on the title page, table of contents, or introduction that the 2015 report was a draft. At the time of the 2015 report, modeling work for Tasks 14, 18 and 19 were not complete.

The 2016 report present results of work conducted on 19 Tasks, numbered 1 through 19. The previous draft report had the same 19 tasks plus Task 20, which was to assess the appropriateness of the preliminary remediation action level. The Harris County Pollution Control Services Department provided comments on the 2015 report in a letter to the EPA dated September 20, 2015. In the 19 tasks, the USACE performed quantitative analyses and computer modeling to make predictions of the potential short-term and long-term impacts of capping and full removal alternatives for remediation of contaminated sediment at the subject site. The USACE report analyzed numerous variations and optional methods for performing capping or removal operations. A review of the report is contained in the attachment to this letter in a SUMMARY OF RESULTS and SPECIFIC COMMENTS. It is significant to note that the 2016 report does not mention the substantial cap failures that were discovered this year, or the additional sampling that is being conducted this summer. The report also fails to consider the ongoing cap integrity testing being conducted by the EPA.

## SUMMARY OF RESULTS

1. **USACE Support Removal.** The USACE provides strong technical support for the full removal alternative done with best management practices (BMP's) to prevent potential short-term releases and long-term impacts of contaminated sediment.
2. **Full Removal with Management Practices Controls Release and is Superior Alternative.** The USACE performed computer modeling using the program RECOVERY to project long-term (500 years) effects on water quality of the capping alternative (3N) compared to the full removal alternative with BMP's (6N\*) (Task 16). The report presents a new Alternative 6N\* which includes full removal and BMP's to control release. On page 175, the USACE report recommends a best practice method for placement of backfill to cover residual contamination after dredging. The recommended method involves carefully placing sand

material in two equal layers, which considerably reduces mixing with contaminated material and suspension. The USACE report concluded.

*The best practice method of placing the material over two layers is far superior and has considerably less flux than the other two placement methods. The flux from this method is also significantly less than that experienced if the current cap remains in place.*

3. **Alternative with Significantly Less Release.** The release for Alternative 6N\* is 10 to the 15th power times less than Alternative 3N. The statement that the flux is “significantly less” is an understatement.
4. **Leaving Cap in Place for 500 Years Creates Uncertainty and Unacceptable Risks.** The above analysis was based on the assumptions that the cap remains intact for 500 years. The USACE concluded that their permanence of the cap is unknown, and that there are risks it would not be permanent. On page 53 (Task 7), the USACE report states the following:

*It is the PDTs [project delivery team’s] professional judgment that the uncertainty inherent in any quantitative analysis technique used to estimate the long-term (500 years) reliability of the cap is very high. This includes the empirical analysis developed by, among others, Blaauw and van de Kaa (1978), Maynard (2000), and Lam et al. (2011) to estimate the potential scour of the cap due to propwash generated by ship traffic since a lot of the site data needed to properly perform this analysis were not available. The estimated uncertainty associated with the propwash analysis is a minimum +/- one order of magnitude. So, if the estimate of prop induced scour is 10 cm, then than (sic) range of uncertainty would be from 1 cm to 100 cm.*

This is a very important factor in evaluation of the long-term reliability of capping alternatives. The analysis with the most accurate predictions has uncertainty of at least one order of magnitude (that is a factor of 10!). The uncertainty of the other analyses is even greater. As an example, this means that if the models predict toe erosion of 3 inches, the actual amount that may occur over a 500 year time period will range from less than 0.3 inches to more than 30 inches. **In this paragraph, the PDTs experts are explaining that it is not possible to make accurate predictions of severe events over a 500 year time period.**

5. **Barge Strikes Pose Unacceptable Danger.** On page 64 (Task 8), the USACE Report makes the following statement for the Northwestern Area where the water depth is over 5 feet and the side slopes are steeper than 5H:1V:

*The water depth is too deep for the slope to be struck by anything other than a loaded barge. The only strike potential is grounding or beaching of the barge. The grounded barge would shear the armor layer and push some of the armor material ahead of the barge up the slope during grounding and pull some armor down the slope during barge removal, exposing perhaps as much as several thousand square feet of the sediment for moderate slopes and as little as several hundred square feet for mild slopes.*

In the event of this type of barge strike, there would be a risk of **uncontrolled release** of the exposed contaminated sediment. For this reason alone, complete removal of the highly toxic waste is justified. A single barge strike could have devastating effect on the environment. If this were to happen during a storm, it could be catastrophic.

6. **Sheet Pile Walls Can Contain Releases During Removal.** On pages 162 to 163 (Task 13), the USACE report refutes statements in the Feasibility Study (FS) that sheet pile walls would not be effective. The USACE report states:



*Leakage through shallow walls can be controlled by covering the walls with plastic sheeting, adding sealants and incorporating the walls within shallow berms, which would allow excavation in the dry. Placing the walls in shallow areas would allow the walls to be taller, limiting their potential overtopping. In deeper waters, sheet pile walls limit flow through the site and can restrict flow to the surface, limiting erosion of residuals, while silt curtains direct flow along the bottom of the water column, promoting the transport of resuspended sediment and allowing erosion of residuals.*

*Gaps between sheet piles could be readily sealed, and there would not be a need to balance water pressures on both sides of the wall. Additionally, the base of the wall is already armored, which would limit the scour potential. For removal operations performed in the wet within sheet pile enclosures with openings to equalize water pressures on both sides of the wall, the sheet pile will virtually prevent erosion of the residuals, reducing releases by at least 70 percent and greatly increasing short-term effectiveness relative to silt curtains.*

**7. The COE states the FS document had numerous mistakes such as:**

- a. BMP not applied consistently to make removal appear not as good as capping.
- b. Sheet pile can be sealed with sheeting and plastic.
- c. Removal can be accomplished in the dry to reduce loss

**8. Removal Alternative 6N\* Eliminates the Risk of Future Releases.** The USACE developed a new full removal alternative, designated 6N\*, that incorporated feasible BMP's. (Task 12) The new full removal option is based on the following conditions:

- Western Cell: Excavate in the dry by constructing berms and installing sheet piles through the berm to raise the effective height to provide protection from storm flows, tidal fluctuations, and wave for 10-year flood events.
- Eastern Cell – Shallow-water portion: Install sheet piles on the north and east sides and tie into existing berms on the south and west side.
- Eastern Cell – Deep-water portion: It was assumed that a sheet pile wall would be installed around this area.
- Northwestern Area: It was assumed that a turbidity curtain or sheet piles would be used since the average water depth is 15 feet.

**9. Best Management Practices Can Prevent Releases During Removal.** The USACE concluded that the above BMP's are feasible and practical for the San Jacinto Waste Pit site. **Removal of contaminated sediment with these BMP's would prevent the release of contaminated sediment** and would therefore protect the environment from short-term impacts during dredging and from the post-dredge impacts alleged in the FS.

On page 164, the USACE report explains how to place clean cover material over residual contaminated sediment that may be present after dredging, which refutes statements in the FS that post-dredge residual contamination could not be controlled. The USACE report states:

*Additionally, if mixing at a rate of 5 percent of the residuals concentration is expected in the 6 inch residual cover when residual concentrations may be quite high without over-dredging or a clean-up pass,*

*then a 12-inch residuals cover should be placed in two 6-inch lifts so that the bioactive zone would be clean following remediation and would yield less diffusive flux than the existing TCRA cap without a geomembrane.*

10. **USACE Estimates are Biased High.** For several key input parameters, the USACE Report used assumptions to make estimates of the “worse-case” scenario. As a result, the predicted releases are biased high and the actual releases will be less than predicted in the USACE report.
  - a. The estimates of post-dredge residual concentrations were made using the “worse-case” scenario by assuming that residuals were 9% of the dredged mass. This is based on a paper published in 2006, which is based on analysis of residuals taken from published studies that were available at that time. The 2006 paper gives a range of residual mass of 5 to 9% of the dredged mass. This paper does not consider recent improvements in equipment or environmental dredging methods, which will result in lower residual sediment.
  - b. The temporary berms and sheet pile containment should be moved further away from contaminated sediment, so that they are installed in areas of low contamination. This will further reduce the potential for short-term impacts related to installing and removing sheet piles.
11. **Hurricanes can be a Significant Event.** A category 2 hurricane simulation in the Corps report that shows 80% erosion of the cap could be possible, but is given little weight. In addition, barge strikes during hurricanes are not even considered when a very significant release of dioxins could take place. The report only presents general barge strike evaluations during normal operating conditions and does not attempt to evaluate those during storm events. This is the more likely scenario over 500 years, as shown on the cover of the document with barges adrift during a flood event.

## **SPECIFIC COMMENTS**

### **Task 2 - Assess San Jacinto River flow and bed scour.**

The authors state that “eustatic sea level rise and subsidence also contribute to the vulnerability of the Site.” However, while stating that the combination of these two factors has resulted in a 1.97 foot change in relative sea level over the past 100 years, they do not attempt to simulate scenarios that involve reasonably expected future sea levels, continuing land subsidence, and climate impacts on storm intensity. We understand that there is a large amount of uncertainty regarding projecting these to the end of the century, not to mention a 500-year period. Climate models project that an increase in global temperatures will result in an increase in the frequency of heavy precipitation events and in intense storms. The USEPA has recently released a Climate Assessment Tool to permit evaluation of climate change impacts on their BASINS suite of water quality models.

### **Task 5 and 6 - Technical review of existing cap and assess ability of existing cap to prevent migration of dioxins.**

In the Conclusion section on page 51, the USACE report makes 5 recommendations for improving the stability and long-term integrity of the cap. The USACE Report recommends that the cap and blended filter be placed on slopes flatter than 3 horizontal to 1 vertical (3H:1V), and preferable 5H:1V to ensure physical stability of the cap and prevent migration of blended filter material downslope. It says that making the cap thicker would virtually



eliminate potential resuspension losses by bioturbation. It is critical to maintain an adequate filter layer between armor stone and contaminated sediment. We agree that these recommendations will improve the cap performance, but do not agree that the cap will be effective over a 500 year period for the reasons explained in our comments.

**Task 7 - Assess long-term reliability (500 years) of the cap under events such as severe storms, hurricanes, and propeller wash.**

On page 53, the USACE report states the following:

*It is the PDTs [project delivery team's] professional judgment that the uncertainty inherent in any quantitative analysis technique used to estimate the long-term (500 years) reliability of the cap is very high. This includes the empirical analysis developed by, among others, Blaauw and van de Kaa (1978), Maynard (2000), and Lam et al. (2011) to estimate the potential scour of the cap due to prop wash generated by ship traffic since a lot of the site data needed to properly perform this analysis were not available. The estimated uncertainty associated with the prop wash analysis is a minimum +/- one order of magnitude. So, if the estimate of prop induced scour is 10 cm, then the (sic) range of uncertainty would be from 1 cm to 100 cm.*

*The uncertainty associated with estimates of the impact of the three processes listed under the fourth bullet above on the long-term reliability of the cap would be even larger. [Note: the three processes are toe erosion, movement of armor rock during a flood and erosion of material below the cap and changes in river flow dynamics and channel morphology].*

This is a very important factor in evaluation of the long-term reliability of capping alternatives. The analysis with the most accurate predictions has uncertainty of at least one order of magnitude (that is a factor of 10!). The uncertainty of the other analyses is even greater. As an example, this means that if the models predict toe erosion of 3 inches, the actual amount that may occur over a 500 year time period will range from less than 0.3 inches to more than 30 inches. In this paragraph, the PDTs experts are explaining that it is not possible to make accurate predictions of severe events over a 500 year time period.

The uncertainties in predictions must be carefully considered when comparing capping alternatives to removal alternatives. There are also uncertainties in predictions of sediment resuspension and residuals for removal alternatives (with excavation in the dry or dredging in the wet). However, higher than predicted releases can be managed and controlled during removal, but are **uncontrollable** with capping alternatives.

**Task 8 - Impact of Barge Strikes.**

The USACE Report considered the potential for barge strikes under different scenarios of water depth and river flow conditions. The USACE Report estimates a probability of 1 in 400 for a significant barge strike to occur in a year and a probability of 1 in 50 for a low-impact strike. For an event with a probability of 1 in 400 in a year, the probability of occurrence in 500 year time period is 71%. For an event with a probability of 1 in 50 in a year, the probability of occurrence in 500 year time period is 99.996%. Under some scenarios, a barge strike is predicted to gouge out the cap material and expose several thousand square feet of contaminated sediment.

On page 64, the USACE Report makes the following statement for the Northwestern Area where the water depth is over 5 feet and the side slopes are steeper than 5H:1V:

*The water depth is too deep for the slope to be struck by anything other than a loaded barge. The only strike potential is grounding or beaching of the barge. The grounded barge would shear the armor layer*



*and push some of the armor material ahead of the barge up the slope during grounding and pull some armor down the slope during barge removal, exposing perhaps as much as several thousand square feet of the sediment for moderate slopes and as little as several hundred square feet for mild slopes.*

In the event of this type of barge strike, there would be a risk of uncontrolled release of the exposed contaminated sediment. For this reason alone, complete removal of the highly toxic waste is justified. A single barge strike could have devastating effect on the environment. If this were to happen during a storm, it could be catastrophic.

The USACE Report states that the impact of strikes during high flood flows are much greater due to potential erosion of exposed sediment; however, flood conditions occur only about 1% of the time so these impacts are unlikely. The USACE Report does not consider the fact that it is much more difficult to control barges during periods of high flood flows or that there is an increased risk of barges breaking free from tugs or moorings during storms when there are high winds and high flood flows. Contrary to assertions in the USACE Report, we believe that barge strikes and grounding are rather more likely under flood (and hurricane) conditions, when they may break free from their moorings. This is exemplified in the cover photo of the USACE report showing barges adrift. We do agree that strike control measures such as pilings are warranted to protect from barge strikes if full removal is not performed. If pilings are used, they should be positioned sufficiently distant from the cap so that recreational boats, which will inevitably tether to them, will not swing and impact the cap.

Based on the fact of substantial local barge operations on the Northwest side of the site and our observations of barge and tugboat operations and maintenance in the Houston Ship Channel system generally, and near the I-10 Bridge in particular, we believe that the probability of a minor strike from a barge or tugboat is significantly higher than stated (1 in 50 years). Even more likely would be impacts from recreational boating and fishing. The potential impact of a barge strike on the cap was judged to be, at most, moderate. The impact of exposing over a thousand square feet of waste material to the River might indeed only be moderate if the damage was reported and soon repaired. It is perhaps more likely that the damage would not be reported, and perhaps not discovered for a significant time such as in a major flood. A substantial mass of waste and contaminated sediment would then be permitted to mix into the River and flow into Galveston Bay. Damage to the toe of the cap may also cause a slope failure that could potentially threaten the integrity of the whole cap, especially in floods and release significant chemicals.

#### **Task 10 - Document cases of armoring breaches relevant to the San Jacinto site.**

The USACE Report performed a literature review to research documented cases of breaches in armored caps or armored confined disposal facilities. They did not find any case of breaches in armored caps; however, there have been many occurrences of breaches and slope failures in armored dikes, jetties and breakwaters. The USACE Report includes a table that summarizes the breaches at 10 sites in the United States and gives the following summary on page 82:

*The cases shown in Table 10-1 represent varying situations that may be of some relevance to the San Jacinto site investigation because the site is adjacent to a well-traveled waterway with significant wave action due to navigation, is subject to large storm events that may cause large inflows of water from overtopping the CDF, and has armored slopes with synthetic material acting as a filter or liner that is susceptible to tears that allow erosion to degrade the system.*

The literature review shows that there have been breaches in armored caps in conditions similar to those at the Site.



On pages 82 and 86, the USACE report states:

*The three modes of armor failure presented above apply as well to the San Jacinto River Waste Pits TCRA armor cap. There is potentially ineffective filtering between the armor stones and the sediment in the Northwestern Area. The blended media filter used in the Northwestern Area may have not been fine enough or placed uniformly enough to prevent fine sediment from migrating into the armor cap. A cap defect that appeared in the Northwestern Area in 2015 may have resulted from ineffective filtering. Addition of more filter material or cohesive material along with more armor stone in the Northwestern Area will restrict migration of sediment through the armor cap.*

*Examination of the armor stability under very severe hydrodynamic and hydrologic events (100-yr hurricane) showed that the 3-inch recycled concrete placed in the Northwestern Area is insufficient to prevent erosion from the wave and current induced bottom shear stresses. The existing armor stone should be supplemented with six-inch armor stones to provide stability during the extreme storm events. In addition, some of the six-inch armor stones in Western and Eastern Cells were also insufficient. The six-inch armor stones should be supplemented with eight-inch armor stones to prevent their displacement.*

**The USACE states the existing cap is insufficient for controlling releases.**

**Task 11 - Assess potential resuspension and residuals under capping, solidification and removal alternatives.**

In this section, the USACE Report made quantitative estimates of the mass of sediment particles and mass of contaminants released to the water due to sheet pile installation/removal, removal of existing armor cap materials, removal of existing geotextiles, and dredging in the wet (i.e. removal of sediment from underwater using dredging equipment). The USACE Report also made quantitative estimates of the post-dredge residual concentrations. These were made for FS alternatives 4N, 5N, 5aN, and 6N.

The methods used in the USACE Report to make quantitative predictions are reasonable and were done using state-of-art methods. However, even the best methods require a number of assumptions of input parameters and there is significant uncertainty in the results.

In the scenarios involving placement of a sheet pile wall, the results are highly dependent on the sediment dioxin concentration in the material in which the sheet pile is placed. There is no reason the wall needs to be installed right at the excavation boundary; it should be placed at some distance from the excavation, where concentrations are less than 50 ng/kg at the surface and (in most cases) decline with depth. Even if the sheet pile wall were placed at the locations with surface concentrations of 1,000 ng/kg, the concentrations typically decline with depth such that the average concentration that adhered to the 15 feet of sheet pile would likely be at least an order of magnitude lower than at the surface.

If the sheet pile wall were installed on or slightly outside of the perimeter of original impoundments, the dioxin releases during its installation would be minimal because the sediment concentrations are mostly less than 50 ng/kg. It is more logical to assume you would not install sheet pile into the sediment where the concentrations are the highest. The wall should then minimize releases of dioxins during cap removal, excavation, and dredging.

**Task 12 – Identify and evaluate Best Management Practices (BMP's) to minimize sediment resuspension and residual concentrations during and after dredging.**

The USACE developed a new full removal alternative, designated 6N\*, that incorporated feasibly BMP's. The new full removal option is based on the following conditions:

- Western Cell: Excavate in the dry by constructing a berms and installing sheet piles through the berm to raise the effective height to provide protection from storm flows, tidal fluctuations, and wave for 10-year flood events.
- Eastern Cell – Shallow-water portion: Install sheet piles on the north and east sides and tie into existing berms on the south and west side.
- Eastern Cell – Deep-water portion: It was assumed that a sheet pile wall would be installed around this area. However, it was assumed that all the sediment re-suspended during dredging was “lost” (i.e. migrated outside the sheet pile and into the surface water).
- Northwestern Area: It was assumed that a turbidity curtain or sheet piles would be used since the average water depth is 15 feet.

With the above condition, they calculated sediment and contaminant losses using the same methods as in Task 11 and the results are presented in Table 12-19.

A comparison of the predicted sediment and contamination loss for Alternative 6N as described in the FS and with best management practices is shown below (based on Tables 11-19 and 12-19). For the new alternative, most of the predicted loss was from the Northwestern Area, where the USACE Report assumed silt curtains or sheet pile would be used.

Alternative	Control Method (BMP)	Mass of dry solids “lost” (metric tonnes)	Mass of contaminant “lost” (g)
6N	Silt curtains	2,600	14.7
New Full Removal with silt curtain in deep water	Sheet piles, excavation in dry where feasible, silt curtain in Northwest Area	670	2.4
New Full Removal with sheet pile in deep water	Sheet piles	290  (based on note 3 in Table 12-19)	1.2

The USACE estimates of potential contaminated sediment releases were based on several conservative or worst-case assumption, which over-estimates the potential releases. Actual releases could be much lower if excavation is conducted in the dry.

- On page 134 the USACE report states that excavation and backfilling in the dry in the Western Cell will eliminate potential resuspension and residual releases. However, in Table 12-19, they show an estimated release of 50 metric tons of contaminated sediment.
- On page 143 the USACE report states that it may be possible to excavate the shallow water portion of the Eastern Cell in the dry if a berm were constructed; however, the estimated resuspension was calculated for dredging in the wet for comparison. In the Conclusion section of page 152-153, the USACE report recommends that whenever possible activities should be completed in the dry, such as the



shallow portion of the Eastern Cell. It says that by constructing a berm and sheet pile wall structure, the area can be completely dewatered and all activities completed in the dry. However, in Table 12-19, they show an estimated release of 19 metric tons of sediment from the Shallow Water portion of the Eastern Cell.

- On page 135, the USACE report states that with the installation of sheet pile in shallow water areas, they assumed loss of all material suspended during dredging operations. This is an overly conservative assumption. The only possible pathway for release of suspended sediment would be through joints in the sheet piles. It is common practice to weld two sheets together and drive them in pairs. This reduces the potential release by 50%. This potential release could be essentially eliminated by installing sealant in the joints or by keeping the water level inside the sheet pile enclosure below the water level in the river outside the sheet pile. If the water level inside the sheet pile was kept at the low tide level, then there would not be any flow of water or suspended sediment out of the enclosure.
- On page 135-136, the USACE report states that with sheet pile in the deep water areas, they assumed that the wall would allow tidal interchange of river water and assumed a “worst-case” scenario that all re-suspended material was lost during dredging activities. As explained in the previous comment, the potential releases with sheet pile will be less than estimated in the USACE report.
- On page 138, the USACE report states that contaminated sediment would be released when sheet piles were installed and removed in areas of surface contamination. This can be reduced by installing the sheet pile outside the areas of the highest sediment concentrations.
- On page 146, the USACE report states that the estimates of post-dredging residual concentrations are based on a “worst-case” scenario that the mass of residual sediment is 9% of the mass of dredged sediment. This is the upper end of a range based on one paper published in 2006. Improvements in dredging equipment and procedures since 2006 have reduced the mass of residual sediment.
- On page 153 in the Conclusion section, the USACE report acknowledges that the predicted releases would be decreased by 50% in the shallow water areas where excavation was done in the dry as opposed to dredging in the wet.
- Footnote 3 to Table 12-19 states that if sheet pile walls were used in all deep water areas, the predicted releases would be reduced by 40% to an overall contaminated release rate of 0.2%.

**If all BMP's were employed, the release rate would be less than 0.2%.**

**Task 13 – Assess the validity of statements made in the Feasibility Study about the impacts of Alternative 4.**

On pages 160 and 161, the USACE report points out that the FS is inconsistent in application of BMP's to the same work in different alternatives. For example, the USACE report states that it appears the removal in the Western cell is performed in the dry in Alternative 5N, but in the wet in Alternative 6N. The USACE reports concludes:

*Consequently, the performance of the alternatives as predicted in the fate and transport modeling tends to distort the incremental impacts of expanding the comprehensiveness of the removal alternatives.*

On pages 162 to 163, the USACE report refutes statements in the FS that sheet pile walls would not be effective. The USACE report states:

*Leakage through shallow walls can be controlled by covering the walls with plastic sheeting, adding sealants and incorporating the walls within shallow berms, which would allow excavation in the dry. Placing the walls in shallow areas would allow the walls to be taller, limiting their potential overtopping.*

*In deeper waters, sheet pile walls limit flow through the site and can restrict flow to the surface, limiting erosion of residuals, while silt curtains direct flow along the bottom of the water column, promoting the transport of re-suspended sediment and allowing erosion of residuals.*

*Gaps between sheet piles could be readily sealed, and there would not be a need to balance water pressures on both sides of the wall. Additionally, the base of the wall is already armored, which would limit the scour potential. For removal operations performed in the wet within sheet pile enclosures with openings to equalize water pressures on both sides of the wall, the sheet pile will virtually prevent erosion of the residuals, reducing releases by at least 70 percent and greatly increasing short-term effectiveness relative to silt curtains.*

On page 164, the USACE report explains how to place clean cover material over residual contaminated sediment that may be present after dredging. The USACE report states:

*Additionally, if mixing at a rate of 5 percent of the residuals concentration is expected in the 6 inch residual cover when residual concentrations may be quite high without over-dredging or a clean-up pass, then a 12-inch residuals cover should be placed in two 6-inch lifts so that the bioactive zone would be clean following remediation and would yield less diffusive flux than the existing TCRA cap without a geomembrane.*

**Task 16** – Project long-term (500 years) effects of the capping alternative (3N) compared to the full removal alternative (6N) on water quality.

The Corps performed modeling using the program RECOVERY to calculate the flux of contaminants for the cap alternative and the full removal alternative. In this analysis, they assumed that the cap remained intact. There is NO consideration of future releases in the event that the cap is damaged.

For the full removal alternative, the Corps performed modeling with three different methods of placing clean cover soil over the site after dredging. On page 175, the USACE report recommends a best practice method for placement of backfill to cover residual contamination after dredging. The recommended method involves carefully placing sand material in two equal layers, which considerably reduces mixing with contaminated material and suspension. The USACE report states:

*The best practice method of placing the material over two layers is far superior and has considerably less flux than the other two placement methods. The flux from this method is also significantly less than that experienced if the current cap remains in place.*

Table 16-10 gives the estimated total contaminant release of 500 years for Alternative 3N and give releases for three different backfill placement methods for Alternative 6N. The total release is summarized below:

Alternative 3N – (with improved cap)	10.3 mg
Alternative 6N* with best backfill placement–	2.4 x 10 <sup>-15</sup> mg

The release for Alternative 6N is 10 to the 15th power times less than Alternative 3N. **The statement that the flux is “significantly less” is an understatement.**

**Task 18** – Assess potential for release of material from Waste Pits caused by storm during removal/dredging operations.



Regarding Task 18, we believe the risks of a hurricane or tropical storm during dredging operations could be reduced by performing the work during the roughly half of the year when they seldom occur. The impacts could also be substantially lessened by doing the work in phases, with relatively little exposed sediment at any time, and by surrounding the Site by a sheet pile wall reinforced by the clean armor stone that is being removed from the cap surface. In addition, these risks would be minimized by simply watching the weather forecasts for potential storms. With advance warnings, there would be ample time to take measures to cover site and prevent releases.

The USACE report agrees with the above approach. On page 186, the USACE report states:

*In these circumstances, it would be advisable to perform the removals in small sections at a time such that the armor stone and geotextile within the small section would be removed, and then the sediment removed and a thin layer of sacrificial fill placed before advancing to the next section and repeating the process. Under these removal operations, it would also be advisable to limit or restrict removal activities to a period when there is lower probability of tropical storms and flooding conditions.*

Very truly yours,

A handwritten signature in blue ink, appearing to read "Mark Otten and Randy Palachek", with a long horizontal flourish extending to the right.

Mark Otten and Randy Palachek

Parson Environmental & Infrastructure Inc.

(TBPE F- 7652)